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<td><strong>Author(s)</strong></td>
<td>Leow, Dayton Wei Yang</td>
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Category: 1  School of Humanities and Social Sciences

Student: Leow Wei Yang Dayton  Project ID: HSS13029

Age-related Differences in Functional Connectivity during Scene Encoding

Introduction
• The functional network underlying episodic encoding involves both the prefrontal cortex (PFC) and medial temporal lobe (MTL). 
• Episodic encoding differs in terms of the stimuli and the types of encoding.
• Past neuroimaging studies have found both the parahippocampal in the MTL and inferior frontal gyrus (IFG) in the PFC to be activated for scene encoding. In addition, when scenes are encoded based on their meaningfulness (i.e., relational encoding), the hippocampus will be activated for relational binding of the stimuli.
• In general, there is converging support for both the IFG and MTL (hippocampus/parahippocampus) to be functionally connected and work in tandem during relational encoding of scenes.
• Older adults performing relational encoding and scene encoding exhibited increased frontal activation than young adults to meet their increased cognitive demand.
• Specifically, an increased frontal activation was shown to compensate for the decreased medial temporal activity.
• The posterior-to-anterior shift in aging (PASA) model could potentially be used to account for this medtemporal-to-frontal inferor compensatory shift in brain activation.

Aims
1. To examine the difference in IFG-MTL functional connectivity between young and older adults while performing relational encoding of scenes.
2. To use the finding to extend support for the PASA model.

Hypotheses
1. Both young and older adults are expected to show increased functional connectivity between IFG and MTL during relational encoding of scenes.
2. Older adults are expected to show reduced functional connectivity between IFG and MTL during relational encoding of scenes compared to the young.

Method
Participants
16 healthy old adults (9 F, 2 left-handed) mean age = 66.2 (SD = 6.5) MMSE mean score = 29.3 (SD = 0.7)
23 healthy young adults (12 F, 2 left-handed) mean age = 23.3 (SD = 2.2) MMSE mean score = 29.9 (SD = 0.3)

Task
Relational encoding of scenes: Non-scrambled novel (N) vs scrambled novel scenes (S) task contrast.
Accuracy (ACC) and reaction time (RT) during scan were recorded; post-scan recall was tested for unintentional encoding.

Image acquisition and preprocessing
All participants’ brain images were acquired in a 3.0 T MRI scanner (EP: parameters: TE 30 ms, TR 3000 ms, FOV 192 mm, matrix 64x64, slice thickness 3 mm, 39 axial slices with 0.75 mm gap).
Preprocessing was carried out using statistical parametric mapping 8 (SPM 8) on MATLAB 7.9, following the diffeomorphic anatomic registration through exponentiated lie algebra (DARTEL) pipeline.

Results

Aims & Hypotheses

Behavioral results
• Old vs young adults showed significant main effects of group (Old > young) on hit rates and RTs, and a marginal increase of FC between right and left MTL. Old adults also showed a marginal increase of FC between right and left MTL and had longer RT at p < .06 (FDR corrected). Old adults had an increased FC between the right and left MTL compared to the young.

Connectivity analyses
• Older adults responded slower than young adults for both conditions, with reaction time being slower for scrambled novel scenes than non-scrambled condition.
• Only older adults showed functional connectivity between IFG and MTL during relational encoding of scenes, while young adults had connectivity between left and right MTL, partially supporting the first hypothesis.
• Contrary to the second hypothesis, no age-related difference in IFG-MTL functional connectivity was found to suggest a PASA phenomenon. However, the present finding showed increased functional connectivity between left and right MTL in the elderly compared to the young when performance and brain atrophy is controlled for. These results could be generalized to the CRUNCH model that suggests a functional compensation in aging.

References

Project Title: Healthy Aging in the Brain
Supervisor: Assoc Prof Chen Shen-Hsing Annabel

Collaborator: Dr Jo Archer